

COMPREHENSIVE GROUND WATER MONITORING EVALUATION

OF

E.I. DU PONT DE NEMOURS & COMPANY, INC.

PICKAWAY COUNTY

OHD004287322

OHIO ENVIRONMENTAL PROTECTION AGENCY

September 29, 1988

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GENERAL BACKGROUND INFORMATION

Purpose

The purpose of this report is to document the results of a Comprehensive Ground Water Monitoring Evaluation (CME) of E. I. Du Pont De Nemours & Company, Inc. (Du Pont), Circleville, Ohio plant. A CME is an in-depth evaluation of the adequacy of a facility's ground water monitoring program. Facilities which are required to comply with Resource Conservation and Recovery Act (RCRA) ground water monitoring regulations are subject to a CME.

This CME was completed to determine the adequacy of Du Pont's Ground Water Monitoring Program as it relates to the surface impoundments and an auxiliary (sludge) drying area.

Inspection Checklists

At the back of this report are checklists from the Interim Status Ground Water Monitoring Program Evaluation (comments in reference to the checklists are attached). The checklists deemed appropriate for this facility are:

- ° APPENDIX A (First Page): Comprehensive Ground Water Monitoring Evaluation Worksheet (p. 24v).
- ° APPENDIX A-1: Facility Inspection Form for Compliance with Interim Status Standards Covering Ground Water Monitoring (pp. 46v-50v).

v= Checklist and attachment pages

Information Sources

This report is based upon both a review of Ohio EPA files, which include the documents listed below, and an August 4, 1988 CME site inspection conducted by Ohio EPA, Central District Office representatives: Andrew Kubalak, Division of Solid and Hazardous Waste (DSHWM); Linnea Saukko and Patrick Nortz, Division of Ground Water (DGW).

- ° Ground Water for Industry in the Scioto River Valley: Buried Valley Investigation, Report No. 1, State of Ohio, Department of Natural Resources, Columbus, Ohio, 1965.
- ° The Ground Water Situation in the Circleville Area, Pickaway County, South-Central Ohio, Stanley E. Norris, U.S. Geological Survey, Columbus, Ohio, 1975.
- ° Circleville Plant Well Water Study, J. Foley, E. I. Du Pont De Nemours & Company, Inc., Wilmington, Delaware, July 1968.
- ° Soil Survey of Pickaway County, United States Department of Agriculture, Soil Conservation Service, 1980.

- ° Circleville Plant - Wastewater Basins: Revised Ground Water Monitoring Plan, E. I. Du Pont De Nemours & Company, Inc., Circleville, Ohio, June 23, 1988.
- ° Letter to Ohio EPA from Du Pont concerning the vinylidene chloride (VCl_2) release incident at the Du Pont, Circleville Plant, June 9, 1981.
- ° Letter between Du Pont, Circleville and the Du Pont Corporate Office which concerned ground water monitoring well installations, February 3, 1986.
- ° Letter to Ohio EPA from Du Pont stating remediation activities related to the acetone/pyridine release at Du Pont, March 28, 1988.

Site Location

Du Pont is located about two miles south of Circleville, Pickaway County, Ohio on the western side of Interstate 23 (see Figure 1). The site is bordered to the west-northwest by the Scioto River and its channel, to the east by railroad tracks, and to the north, south, and west by agricultural fields with woodlands between some of the fields (see Figure 2). There is an undetermined number of households in the vicinity of the site, mostly along Interstate 23. Nearby industrial plants with their distance and direction from the Du Pont site are as follows:

- Nekoosa Packaging (formerly Owens-Illinois): 2,000 feet due east of Du Pont's eastern property boundary.
- PPG: 2,200 feet east of Du Pont's eastern property boundary, adjacent to Nekoosa Packaging's southern property boundary.
- Circle Plastics: 1,200 feet due east of Du Pont's eastern property boundary.
- RCA: 2,500 feet north-northeast of Du Pont's northern property boundary.

Figure 3 is a map showing locations of the above facilities.

Figure 1

Du Pont's Location in Central Ohio

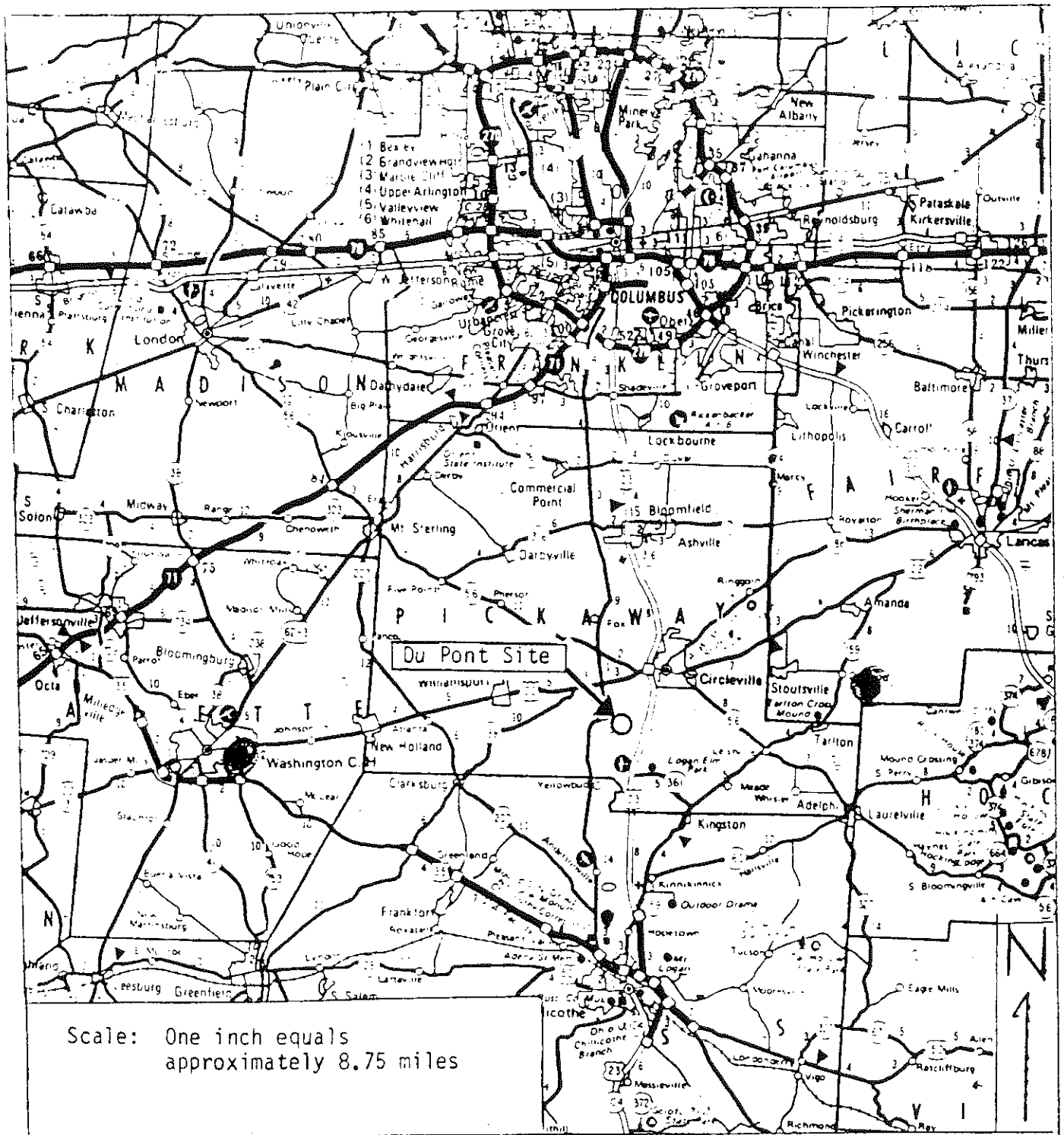


Figure 2
General Site Plan for the
Du Pont Plant (Circleville)

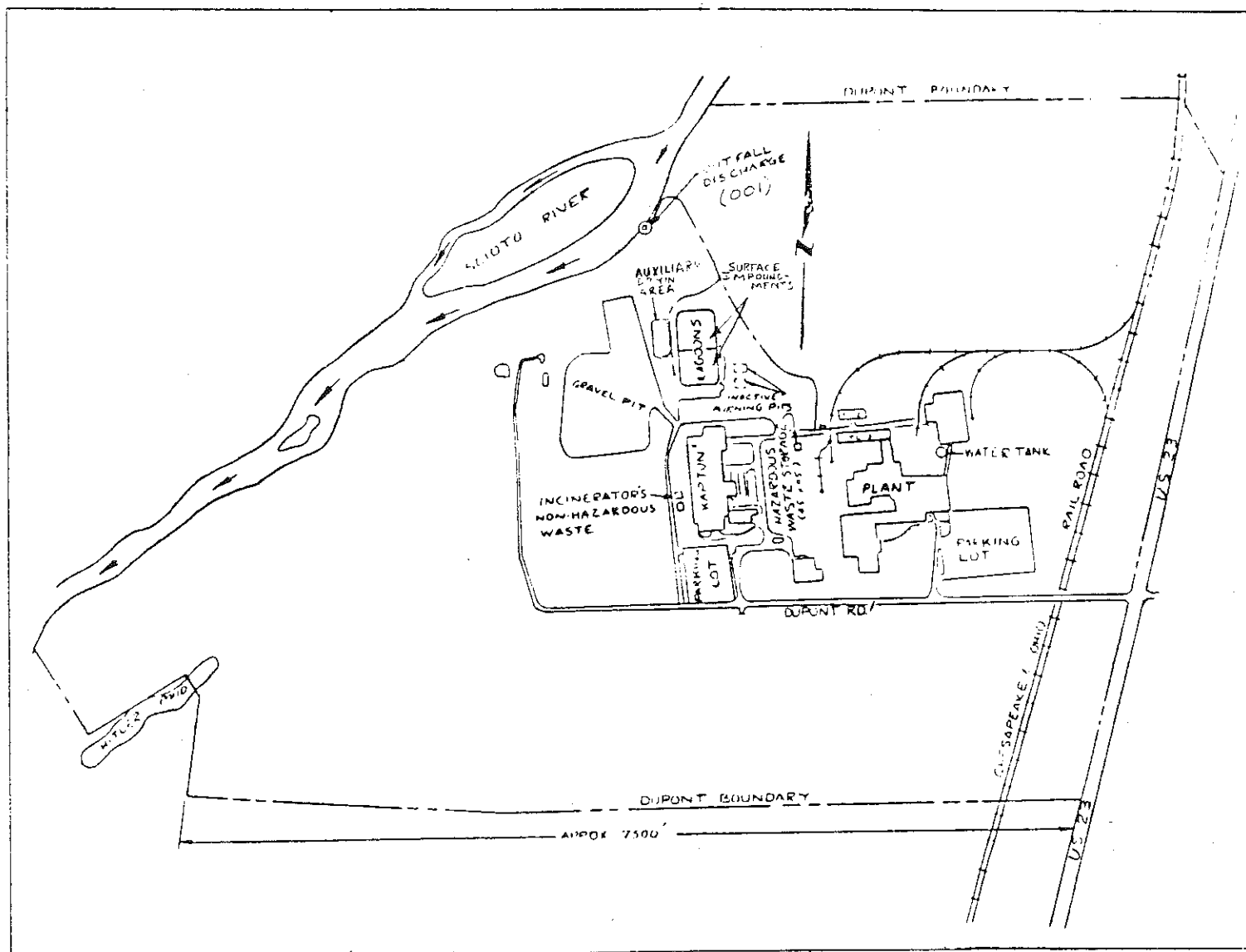
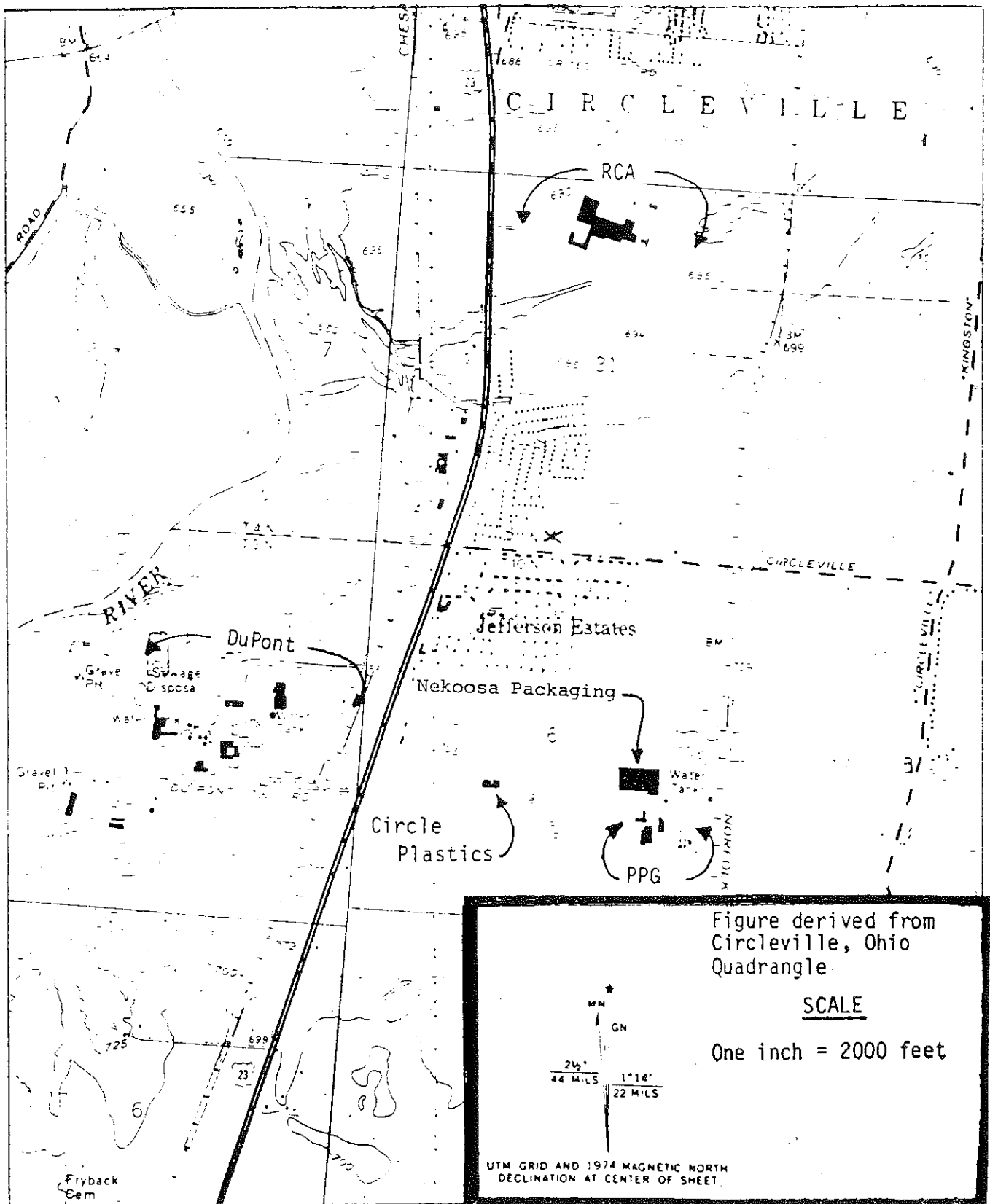


Figure 3
Locations of Industrial Facilities



Description of Facility Operations and History

Du Pont-Circleville began operations in November of 1953 and currently operates as a RCRA Treatment, Storage, and Disposal Facility (TSDF).

Du Pont's-Circleville Plant converts chemical intermediates into polyester film, polyimide film, fluorocarbon film, and polyimide resin. Attachment A, at the back of this report, describes the products manufactured at the Circleville Plant. Plant processes and economics are based upon recovery and recycling of process solvents and reaction compounds.

Part A Permit, Waste Handled, and Codes

The current Part A Permit (June 7, 1988) indicates Du Pont can accumulate up to 16,000 gallons of hazardous waste on site. A 45' x 45' fenced-in gravel area is used for storing containerized hazardous waste, which is regulated under RCRA.

Hazardous waste streams currently generated consist of a spent acetone/pyridine mixture. This mixture is stored in a 50,000 gallon above-ground tank prior to being recycled on site. The still bottoms from solvent recovery are manifested off site. Small volumes of lab and process wastes and other miscellaneous materials having hazardous characteristics are stored in 55 gallon containers.

Hazardous wastes handled (generated) at Du Pont are listed below. The hazardous waste numbers indicated below are as defined in 40 CFR Part 261:

- D001: Hazardous waste characteristic of ignitability
- D002: Hazardous waste characteristic of corrosivity
- D003: Hazardous waste characteristic of reactivity
- D006: E.P. toxic for cadmium
- D007: E.P. toxic for chromium
- D008: E.P. toxic for lead

F002: The following spent halogenated solvents: Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane: all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005 and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F003: The following spent non-halogenated solvents: Xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing before use, one or more of the above non-halogenated solvents, and a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F005: The following spent non-halogenated solvents: Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxy-ethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

U080: Methane, dichloro -

Table 1 shows the amount of hazardous waste generated each year as indicated by annual reports filed by Du Pont.

On May 5, 1981, it was confirmed that an underground transfer line had been leaking 1,1-dichloroethylene. (Note: 1,1-dichloroethylene has been identified by Du Pont as vinylidene chloride, VDC, and VCl_2 . The remainder of this report will use the VCl_2 abbreviation for identification of 1,1-dichloroethylene). It was subsequently discovered that it had entered the ground water. Ground water which is contaminated with VCl_2 (hazardous waste number U078) is currently pumped and treated by an air stripping unit (installed in July 1986) and immediately discharged to the storm water system, which discharges to the Scioto River. Du Pont has an NPDES permit and an air permit for this discharge. Prior to July 1986, the facility used their north and south surface impoundments (identified by Du Pont as the north and south bio-ponds or wastewater basins) for the treatment and storage of this U078 hazardous waste. In October 1985, hazardous waste sludge from the north surface impoundment was pumped to an auxiliary drying area for dewatering. Figure 4 shows locations of the waste management units at Du Pont, including the surface impoundments (location 27) and the auxiliary drying area (location 7). Table 2 describes the numbered units in Figure 4. As a result of negotiations with U.S. EPA-Region V, Du Pont has drained the south surface impoundment and dewatered the sludge on site. The sludge has been disposed of off-site at Chemical Waste Management Inc. (permitted TSDF), located in Fort Wayne, Indiana.

On February 7, 1988, a hazardous waste (an acetone/pyridine mixture) release through a pump filter valve occurred at the SP Resin Tank Farm. Du Pont estimates that 503 gallons were recovered from a 571 gallon spill. Remediation to date includes the excavation and removal of 275 tons of soil contaminated with waste acetone/pyridine. Soil contaminated from this hazardous waste release has been disposed of at Chemical Waste Management, Inc., Fort Wayne, Indiana, and at Ross Incineration, Grafton, Ohio.

Ground water monitoring wells were installed surrounding the area of the waste acetone/pyridine release area. Further discussion of the chemical release is included in this report's sections on 1) ground water monitoring; 2) ground water contamination; and 3) soil contamination.

TABLE 1
AMOUNT OF HAZARDOUS WASTE GENERATED ANNUALLY

<u>Year</u>	<u>AMOUNT (LBS)</u>
1987	3,049,625
1986	1,010,377
1985	225,450
1984	290,150
1983	31,214
1982	502,055
1981	420,483

Figure 4

LOCATION OF WASTE MANAGEMENT UNITS
AT THE DU PONT SITE
See corresponding table 2

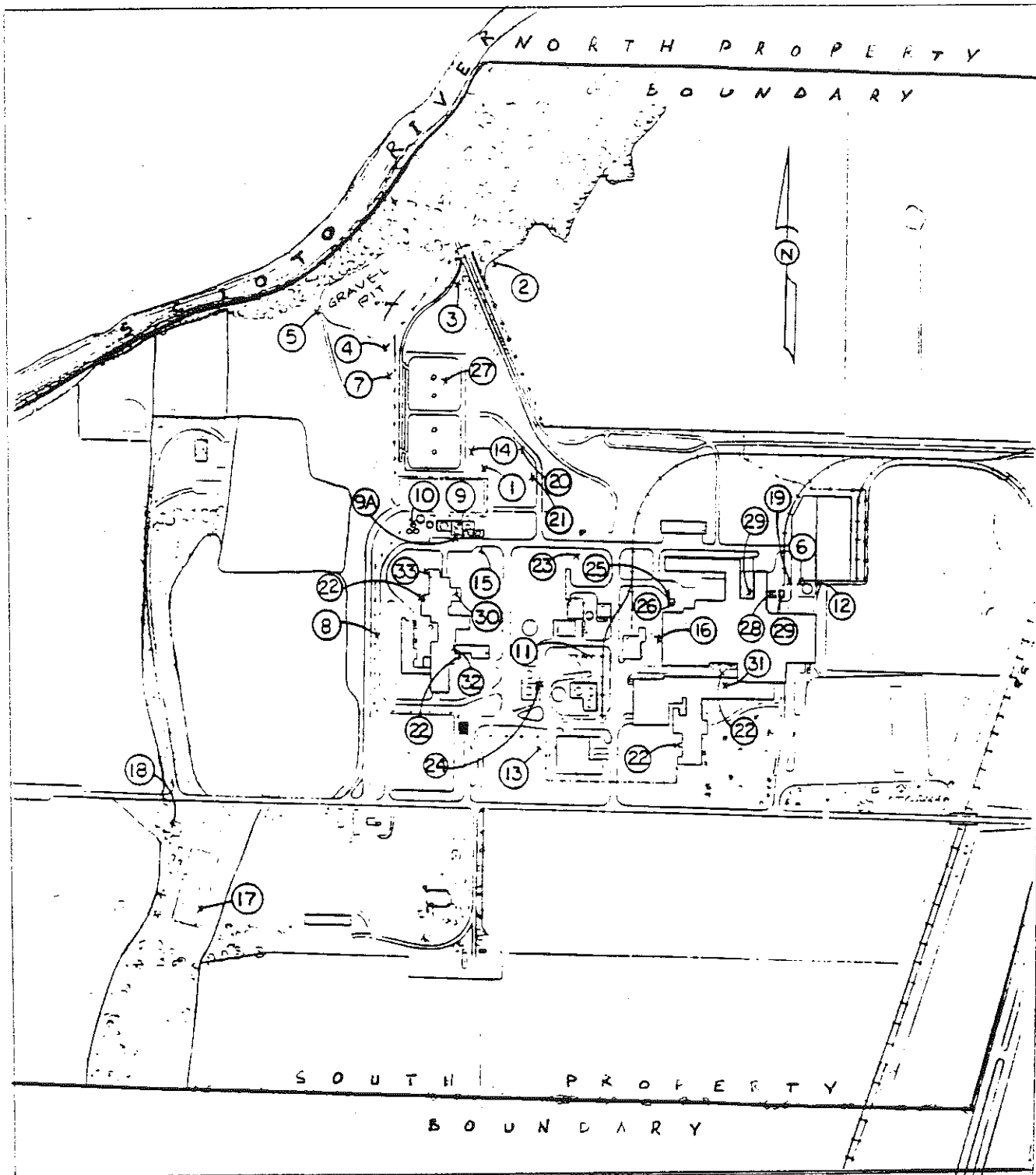


Table 2(1 of 8)

WASTE MANAGEMENT UNITS							WASTE		
NAME	DESCRIPTION	LOCATION (See Map Attached)	CAPACITY AND/OR DIMENSIONS	SERVICE FUNCTION	DATE	PRESENT STATUS	DESCRIPTION	CLASSIFICATION UNDER RCRA	QUANTITY AND/OR VOLUME
Burning Pits (2)	Open Burning area	1	80'x80'x12' deep 80'x80'x12' deep	Disposal	1954-1965 1954-1970	Both pits have been filled in with dirt	Inert polyester film, monomer and polymer; oil, grease, lab chemi- cals, packaging & construction mtl's	Hazardous & nonhazardous	2,850 yd ³ 2,850 yd ³
River Ravine I	Landfill	2	100'x50'x25' deep	Disposal	1956-1970	Bank extended by covering material with fill dirt	Construction materials & non- combustibles removed from burning pit	Nonhazardous	4,600 yd ³
River Ravine II	Landfill	3	30'x50'x20' deep	Disposal	1953-1955	Bank extended by covering material with fill dirt	Inert polyester mill rolls, monomer, polymer & construction materials	Nonhazardous	1,110 yd ³
Pit	Landfill	4	10'x40'x10' deep	Disposal	1968-1970	Filled in with dirt	Polyester monomer	Nonhazardous	150 yd ³
Open Area	Landfill	5	Material spread over ground to dry	Disposal	1972	Plowed in and covered with weeds	Saran coating bath	Nonhazardous	Unknown

Table 2(2 of 8)

ENV 6A (I-291)

WASTE MANAGEMENT UNITS							WASTE		
NAME	DESCRIPTION	LOCATION (See Map Attached)	CAPACITY AND/OR DIMENSIONS	SERVICE FUNCTION	DATE	PRESENT STATUS	DESCRIPTION	CLASSIFICATION UNDER RCRA	QUANTITY AND/OR VOLUME
Ground Water Stripper	Waste water treatment Permitted under NPDES & Ohio EPA	6	34'Hx~8' dia	Treatment	1986- Present	Pack column dis- charge water meets drinking water standard for VCl ₂	Ground water with 3 ppm VCl ₂	Hazardous	700 GPM
Sludge Basin	Surface impoundment	7	250'x75'x4' deep	Storage	1985-	Sludge held in lined basin until dewatering and landfill arrangements complete; study taken to landfill	Waste water treatment sludge	Nonhazardous	600M gallons
South & North Incinerators (2)	Incinerators (2) permitted by Ohio EPA	8	Primary Chamber Dimensions: 4'x3'x2' 4'x3'x2'	Disposal	1972- Present	Both incinerators permitted by the Ohio EPA	Kapton® polyimide gel film	Nonhazardous	30,000 lbs/yr 30,000 lbs/yr
Kapton® Collected Solvent Tanks (3)	Storage tanks (above ground)	9	1- 60,000 gal 1- 60,000 gal 1- 100,000 gal	Storage	1965- Present	Tanks have concrete dikes for secondary containment. Solvent sent off site for reclamation and returned for use in process	Collected solvent, DMAC, D-Picoline, water, acetic acid	Nonhazardous	19MM lbs/yr

Table 2(3 of 8)

WASTE MANAGEMENT UNITS							WASTE		
NAME	DESCRIPTION	LOCATION (See Map Attached)	CAPACITY AND/OR DIMENSIONS	SERVICE FUNCTION	DATE	PRESENT STATUS	DESCRIPTION	CLASSIFICATION UNDER RCRA	QUANTITY AND/OR VOLUME
Kapton® Tank Farm Sumps (2)	Collection and storage basin prior to disposal (below ground)	9A	1- 5000 gal 1- 30 gal	Spill control	1980- Present 1965- Present	Concrete basins for spill control Collection of residual liquid from transfer lines	Water, DMAC D-Picoline, acetic acid	Nonhazardous	Unknown, but believed to be very small
SP Resin Collected Solvent Tank	Storage tanks (above ground)	10	1- 50,000 gal	Storage	1980- Present	Tank has concrete dikes for secondary containment. Solvent sent off site for reclamation and returned for use in process	Collected solvent Acetone, pyridine and water	Hazardous	3MM lbs/yr
Used TEG Tank	Storage Tanks (above ground)	11	1- 14,400 gal	Storage	1954- Present	Liquid sent off site for reclamation and returned for reuse	Triethylene Glycol	Nonhazardous	63,000 lbs/yr
Mobile Equipment Cleaning Station	Concrete Basin (Below ground)	12	3'x7'x6' deep	Storage	1975- Present	Cement basin used to collect grease, dirt, etc. prior to disposal	Dirt, grease, water	Nonhazardous	3000 gal/yr

Table 2(4 of 8)

WASTE MANAGEMENT UNITS							WASTE		
NAME	DESCRIPTION	LOCATION (See Map Attached)	CAPACITY AND/OR DIMENSIONS	SERVICE FUNCTION	DATE	PRESENT STATUS	DESCRIPTION	CLASSIFICATION UNDER RCRA	QUANTITY AND/OR VOLUME
CRI Cleaning Solution Collection Tank	Concrete basin (below ground)	13	8'x5'x5' deep	Storage	1969-1977	Emptied concrete basin has been taken out of service and filled with sand	Salt cleaning solutions	Hazardous (oxidizer)	Unknown
Used Oil Drum Pad	Container storage area	14	50'x50'	Storage	1954- Present	Oil stored in DOT approved drums until shipped off site for disposal	Lubricating, cutting and heat transfer oils	Nonhazardous	142,000 lbs/yr
Kapton® Waste Drum Pad	Container storage area	15	60'x30'	Storage	1963- Present	Waste stored in DOT-approved drums on concrete slab until shipped off site for disposal	Kapton® gel film, polymer in dimethylacetamide O-picoline acetic acid	Nonhazardous	257,000 lbs/yr ¹¹
TEG Sludge Tank	Waste settling and storage tank	16	4000 gal	Settling	1965- Present	Tank used for settling dirt, polymer, etc. from TEG (tri- ethylene glycol)	Dirt and polyester polymer	Nonhazardous	28,000 lbs/yr
Cattle Barn Asbestos	Covered storage area	17	20'x50'	Storage	1975- Present	Staging area for double poly bags of asbestos prior to disposal	Asbestos	Nonhazardous	250 yd ³ /yr

Table 2(5 of 8)

ENV 6A (F-291)

WASTE MANAGEMENT UNITS							WASTE		
NAME	DESCRIPTION	LOCATION (See Map Attached)	CAPACITY AND/OR DIMENSIONS	SERVICE FUNCTION	DATE	PRESENT STATUS	DESCRIPTION	CLASSIFICATION UNDER RCRA	QUANTITY AND/OR VOLUME
Sanitary Trash	Trash containers and compactors	Various locations throughout site	Containers: 22 - 3 or 4-yd 6 - 25-yd 9 - 40 yd Compactors: 8	Storage	1954- Present	Emptied daily & trash taken to sanitary landfill	Sanitary trash	Nonhazardous	12 mm lb/yr
Farm Feed Pit	Storage Pad	18	100'x200'	Storage	1954- Present	Storage of poly- ester monomer prior to land- filling material	Polyester monomer	Nonhazardous	250 yd ³ /yr
Dry Sump	Disposal of washing of transfer lines	19	2'x2'	Disposal	1956-1978	No longer in service	Vinylidene chloride Methylacrylate Acrylonitrile	Hazardous	Unknown
Shallow Burning Pit	Disposal of Kapton® waste material by open burning	20	35'x18'x3' deep	Disposal	1965-1972	No longer in service Covered with dirt	Kapton® process waste	Nonhazardous	Unknown
Chemical Waste Burning Pit	Disposal of laboratory chemicals by open burning	21	12'x12'	Disposal	1966-1971	Covered with dirt	laboratory chemicals	Nonhazardous and hazardous	Unknown

Table 2(6 of 8)

WASTE MANAGEMENT UNITS							WASTE		
NAME	DESCRIPTION	LOCATION (See Map Attached)	CAPACITY AND/OR DIMENSIONS	SERVICE FUNCTION	DATE	PRESENT STATUS	DESCRIPTION	CLASSIFICATION UNDER RCRA	QUANTITY AND/OR VOLUME
RCRA Satellite Areas Mylar® QC Lab KTSP QC Lab CRL Lab	Waste collection storage areas	22	6'x6'	Waste Collection	1980- Present	In service	Laboratory chemicals	Hazardous	400# (max)
Sludge Drying Beds	Drying beds for waste water sludge	23	30'x60'	Sludge drying	1954-1970	Removed	Waste water sludge	Nonhazardous	Unknown
Fuel Oil Pit	Tank to collect oil spilled during loading operation (Below ground)	24	5000 gal	Collection for disposal	1954- Present	In service	Water + #2 fuel oil	Nonhazardous	Unknown, but believed to be very small
Additive 19 Limestone Pit	Concrete lime- stone collection sump	25	10x15'	Spill protection	1979- Present	In service	Silicon tetrachloride	Hazardous	Unknown, but believed to be very small
West Add. 19 Limestone Pit	Concrete lime- stone collection sump	26	5x15'	Spill protection	1985- Present	In service	Silicon tetrachloride	Hazardous	Unknown, but believed to be very small

Table 2(7 of 8)

WASTE MANAGEMENT UNITS							WASTE		
NAME	DESCRIPTION	LOCATION (See Map Attached)	CAPACITY AND/OR DIMENSIONS	SERVICE FUNCTION	DATE	PRESENT STATUS	DESCRIPTION	CLASSIFICATION UNDER RCRA	QUANTITY AND/OR VOLUME
WASTE WATER FACILITIES REGULATED UNDER STATE AND FEDERAL REGULATIONS:									
Bioponds (2)	Surface impoundment permitted under NPODES	27	3.5 acres 9.2MM gal.	Waste water treatment	1970- Present	Lagoons have Hypalon® liner & waste water system is in compliance with NPODES permit	Process, storm & sanitary waste water	Nonhazardous	4MM GPD
Used Caustic Tanks (2)	Neutralization & storage tanks (above ground)	28	1- 750 gal 1- 750 gal	Treatment & Storage	1965- Present	Tanks on pad above ground	Caustic & water	Nonhazardous	Included in 4MM GPD site waste water effluent
East & North Settling Basin With Sumps (2)	Waste treatment and storage tank (below ground)	29	E-8'x24'x7' deep N-19'x10'x6' deep S-5'x8'x8'deep (2)	Treatment and storage	1965- Present	These are concrete basins used for settling sludge out of process waste water	Saran sludge and water	Nonhazardous	236,000 lbs/yr sludge decanted
Filter Wash Neutralization Basin - Kapton®	Waste water Treatment Unit (Below ground)	30	5'x3'x1' deep	Treatment	1965- Present	Concrete basin contains limestone to insure neutral pH of wash water to process sewer	Wash water from filter cleaning	Nonhazardous	Included in 4MM GPD site waste water effluent

Table 2(8 of 8)

WASTE MANAGEMENT UNITS							WASTE		
NAME	DESCRIPTION	LOCATION (See Map Attached)	CAPACITY AND/OR DIMENSIONS	SERVICE FUNCTION	DATE	PRESENT STATUS	DESCRIPTION	CLASSIFICATION UNDER RCRA	QUANTITY AND/OR VOLUME
Neutralization Basin - Mylar® QC	Waste water Treatment Unit (Below ground)	31	6'x4'x5' deep	Treatment	1954- Present	Concrete basin contains limestone to insure neutral pH of waste water from laboratory to process sewer	Dimenimus quantities of laboratory chemicals in waste water	Nonhazardous	Included in 4MM GPD site waste water effluent
Neutralization Basin - Kapton® QC	Waste water Treatment Unit (Below ground)	32	5'x3'x4' deep	Treatment	1963- Present	Concrete basin contains limestone to insure neutral pH of waste water to process sewer	Dimenimus quantities of laboratory chemicals in waste water	Nonhazardous	Included in 4MM GPD site waste water effluent
SP Sump	Storage tank (underground)	33	10'x10'x10' deep	Storage	1980- Present	Concrete sump used as collection basin for waste water for testing before discharging to process sewer	Wash & rinse water from process equipment and building drains. Water may contain dimenimus quantity of pyridine, acetone, or SP monomers	Nonhazardous	Included in 4MM GPD site waste water effluent

Regulatory Status

On July 6, 1988 Du Pont-Circleville was inspected by the Central District Office of the Ohio EPA for compliance with Ohio Administrative Code Rules and Title 40 Code of Federal Regulations pertaining to the generation, treatment and storage of hazardous waste.

Due to the treatment and storage of hazardous waste (ground water contaminated with VC1₂, U078) in two surface impoundments and an auxiliary drying area, Du Pont is operating in violation of their hazardous waste Part A permit. During 1988 RCRA inspections, Du Pont was found to be in non-compliance with the following regulations:

1. 40 CFR Part 265, Subpart F and OAC 3745-65-90 through 3745-65-94 (Ground Water Monitoring).
2. 40 CFR Part 265, Subpart K and OAC 3745-67-20 (Surface Impoundments).

On March 30, 1988, U.S. EPA issued a complaint, findings of violation and compliance order to Du Pont-Circleville regarding the surface impoundments and auxiliary drying area.

Ohio EPA informed U.S. EPA of the details of the February 7, 1988 waste acetone/pyridine release.

REGIONAL/LOCAL GEOLOGY, HYDROGEOLOGY, AND TOPOGRAPHY

Regional and Local Glacial and Bedrock Geology

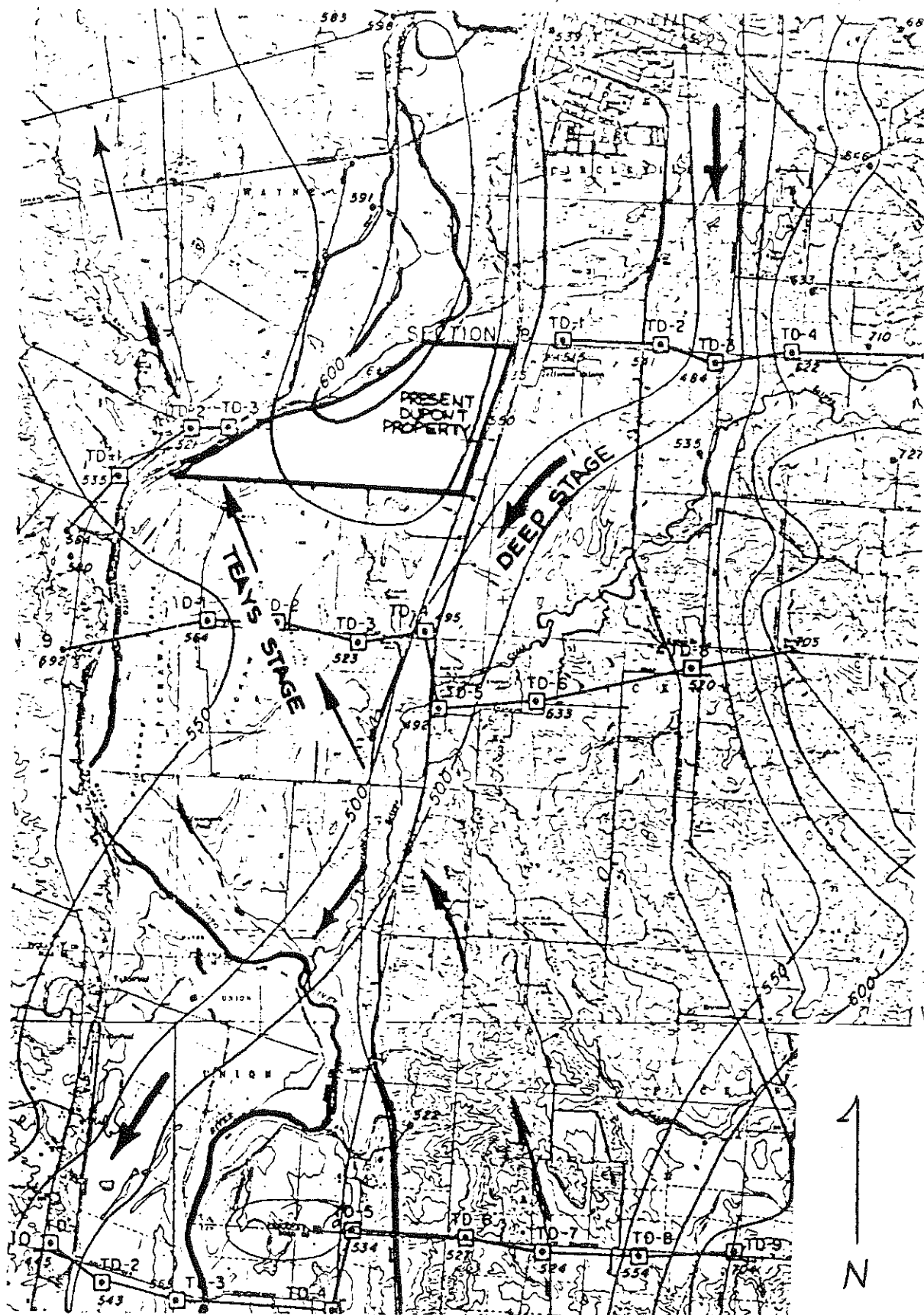
The geology beneath the Circleville area is associated with two ancient drainage systems designated as the Deep Stage and Teays Stage Drainage Systems.

The July 1968 Du Pont report further describes the regional hydrogeology as follows:

The earliest drainage system that can be adequately traced is the Teays. The Teays River was a mature stream which cut a broad valley into the bedrock surface. It entered Ohio from the present Ohio River Valley and flowed northward. Eventually a new system of drainage was established, called the Deep Stage drainage. A major river, the Newark River, was formed. Rising in Northeastern Ohio, it flowed southward. Figure 5 shows both of these drainage systems and the Circleville plant in relation to each, i.e., just east of the Teays Stage Drainage and just west of the Deep Stage Drainage in Pickaway County.

With the advance of the Illinoian and Wisconsin glacial stages (the last two ice advances), the broad, deep channel cut by the Newark River was filled with sand, gravel, and silt. This material was carried and deposited by the melt-waters flowing away from the glaciers. The (glacial outwash) deposits of sand, gravel, and clay which fill these valleys vary greatly, both horizontally and vertically. Comparisons of well logs show

Figure 5
Map of Buried Valleys
Du Pont (Circleville) Plant



Source: State of Ohio - Buried Valley Investigation - Report No. 1

that it is extremely difficult, and often impossible, to trace a particular sand or clay layer from one well to another less than a quarter of a mile away. Although clay layers are present, test drilling has not indicated that they are regionally extensive.

The configuration of the buried valley area at the Circleville plant is best shown on the cross section in Figure 6. The valley does not have a flat, even floor. On the contrary, it is complicated by a bedrock high as well as deep channels cut into the main floor. Here the valley area is separated into two valleys, the western portion being remnant of Teays Stage erosion deepened by later action. The main Deep Stage drainage channel is assumed to have followed the eastern trough. These are shown on the map in Figure 5. The contours on this map are bedrock (elevation) contours. These show the bedrock "high" (Elev. 600), the south end of which is beneath the Circleville plant. Further south the (bed)rock becomes deeper until the area is reached where the Teays and Deep Stage cross, about two miles south of the plant. This is the deepest rock valley east of the Scioto River and it is the broadest section of the saturated sands and gravels; hence, it probably is also the largest reservoir of ground water in the valley.

The aforementioned bedrock which underlies the unconsolidated sediment beneath the site is the black Ohio Shale of Devonian age (350 million years ago). The Ohio Formation is comprised of three significant members, namely, from top to bottom, the Cleveland, the Chagrin, and the Huron. The exact member(s) of the Ohio Formation at the bedrock surface beneath the Du Pont property have not been identified. The depth to bedrock beneath the site varies between 117 feet and 171 feet from the surface.

On-site Soils

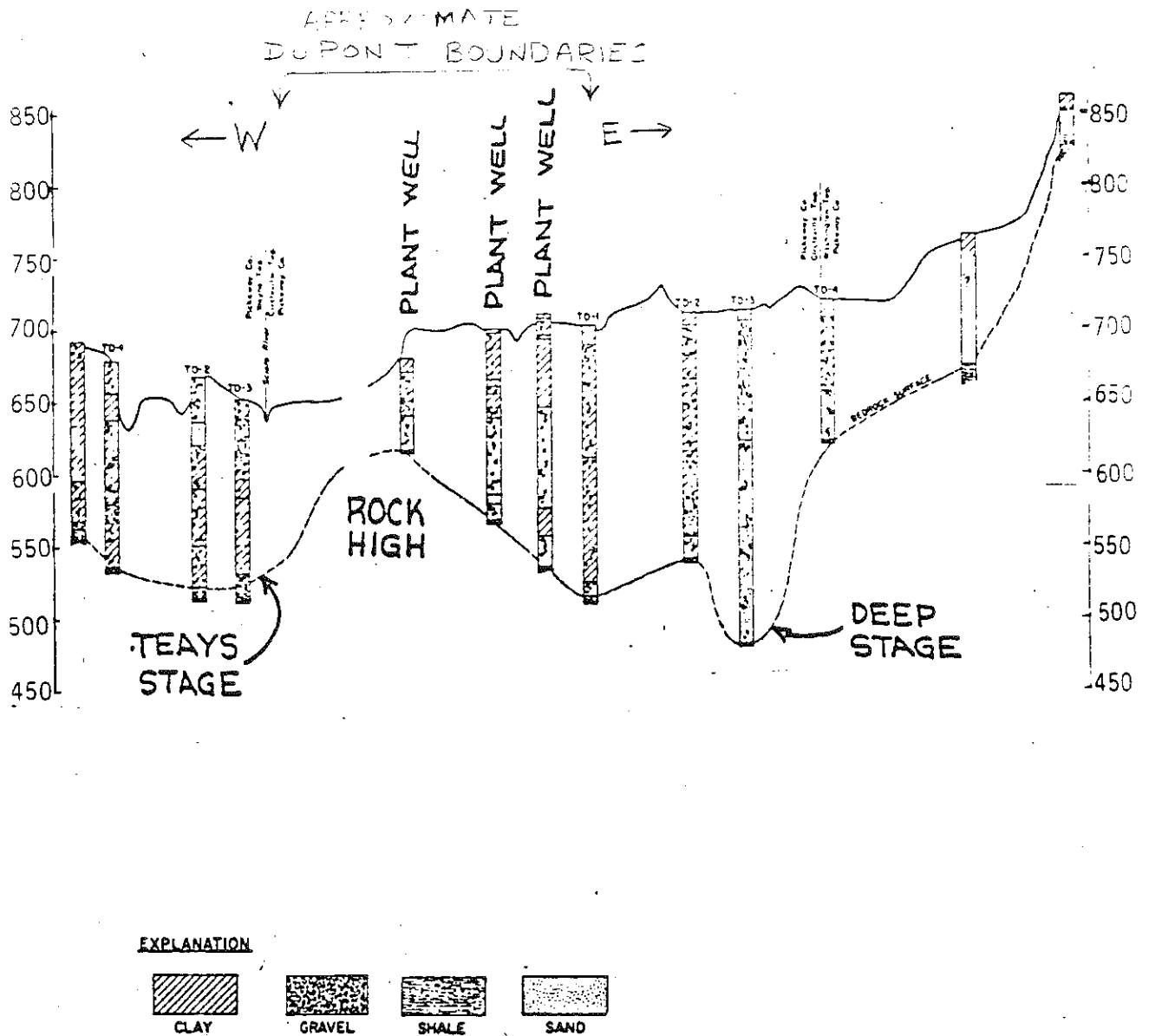
Soils over the Du Pont property are classified as Urban Land (Ur) soils. Urban Land soils are formed from being reworked, due to construction and/or excavation, and they often have a slow permeability. Urban Land soils at the Du Pont site have been reworked from host soils of the Eldean-Warsaw-Genessee-Ross (E-W-F-R) Association, which are nearly level to gently sloping (<6% grade), well drained loams and silt loams. Permeability for E-W-F-R Association soils is slow to moderately slow in the subsoil and moderate to very rapid in the substratum.

Surface Topography and Surface Water

The surface topography on the Du Pont site consists of two fairly flat areas with two different elevation ranges. Du Pont identifies these as the "upper" and "lower" terraces (Du Pont - July 1968).

The "upper" terrace includes the eastern portion of the Du Pont site, extending from U.S. Route 23 to an escarpment, where the surface elevation abruptly drops by about 50 feet to the "lower" terrace. The "upper" terrace

Figure 6
Geologic Cross Section
Beneath Du Pont (Circleville)
Looking North



Source: State of Ohio - Buried
Valley Investigation - Report No. 1

ranges in elevation from about 690 feet to about 710 feet above mean sea level (amsl); it is safe from flooding; and the majority of Du Pont's facilities are located upon it.

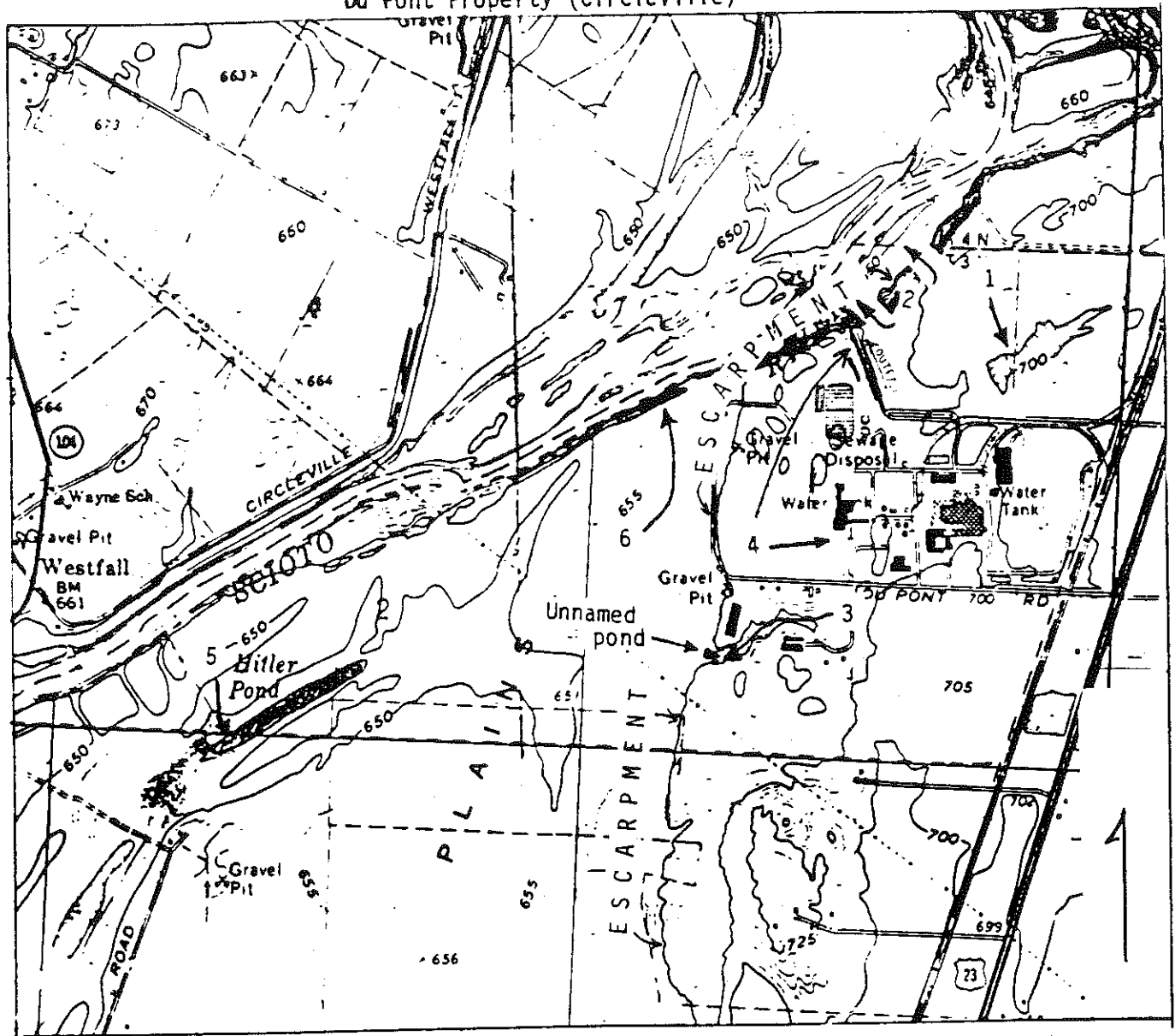
The "lower" terrace is actually the flood plain of the present-day Scioto River; and it covers the portion of the site between the escarpment and the Scioto River, which flows along the western border of the site in a south-westerly direction. The elevation on the lower terrace averages about 650 feet amsl. See Figure 7.

There are two on-site ponds, which normally hold water year-round. The larger of the two is identified as Hitler Pond; the other is unnamed. Their locations are shown in Figure 7.

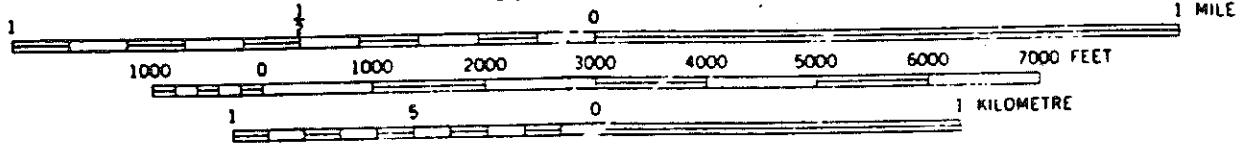
No perennial streams flow across the Du Pont property. The absence of stream flow can be attributed mainly to the high permeability soils, which readily allow for infiltration and movement of fluid. With saturated soil conditions, surface runoff (as indicated on Figure 7) may occur in one of the manners as listed below. These are based upon observations made by the author.

1. On the "upper" terrace, some runoff will flow toward areas of lower elevation, such as the slightly depressed area in the north central portion of the Du Pont property.
2. Some runoff will flow from the margins of the "upper" terrace, down the terrace escarpment, where it will infiltrate into the floodplain soils, or continue over the surface until reaching the river.
3. Some runoff on the upper terrace will be captured by a ravine which leads to the unnamed pond identified previously.
4. Runoff from roofs and pavement which cover the majority of the plant area, will flow into man-made drainage ditches. Runoff from the drainage ditches ends up discharging to the Scioto River via NPDES permit outfall 001. See Figure 7.
5. Some runoff from the flood plain will flow to Hitler Pond.
6. Some runoff from the flood plain will flow directly to the Scioto River.

Figure 7
Topography and Runoff at the
Du Pont Property (Circleville)



SCALE 1:24 000



CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

General Areas of On-site Runoff

- | | |
|---|---|
| 1 - Runoff to depressed areas on upper terrace. | 4 - Runoff to storm drains. |
| 2 - Runoff down terrace escarpment. | 5 - Runoff on flood plain to Hitler pond. |
| 3 - Runoff to unnamed pond. | 6 - Runoff on flood plain directly to Scioto River. |

Uppermost Aquifer

The uppermost aquifer beneath Du Pont consists of the glacial sand and gravel outwash deposits as well as all perched zones overlying these deeper sands and gravels.

The reasons for the perched zones(s) being considered as part of the uppermost aquifer first leads back to one of Du Pont's original conclusions concerning the 1980-81 VCl_2 leak. Du Pont had written (June 9, 1981) that "... a 10 feet thick, very impervious (3×10^{-8} cm/sec) clay layer appears to be continuous under the spill area, and substantially contained the spill from the aquifer". Because the VCl_2 was eventually discovered in the deeper glacial sands and gravels, the water-bearing zone which is contained above the clay zone must be hydraulically interconnected with the underlying glacial deposits. Also, more recent information from Du Pont (February 3, 1986), indicates discontinuities in the confining clay zones, which would allow for connecting pathways between perched water-bearing zones and underlying saturated zones, particularly the glacial sands and gravels. Figures 8A and 8B demonstrate how the clay zones are discontinuous, allowing for hydraulic interconnection of the different zones.

Preferential Flow Paths, Ground Water Surface, and Ground Water Flow Direction

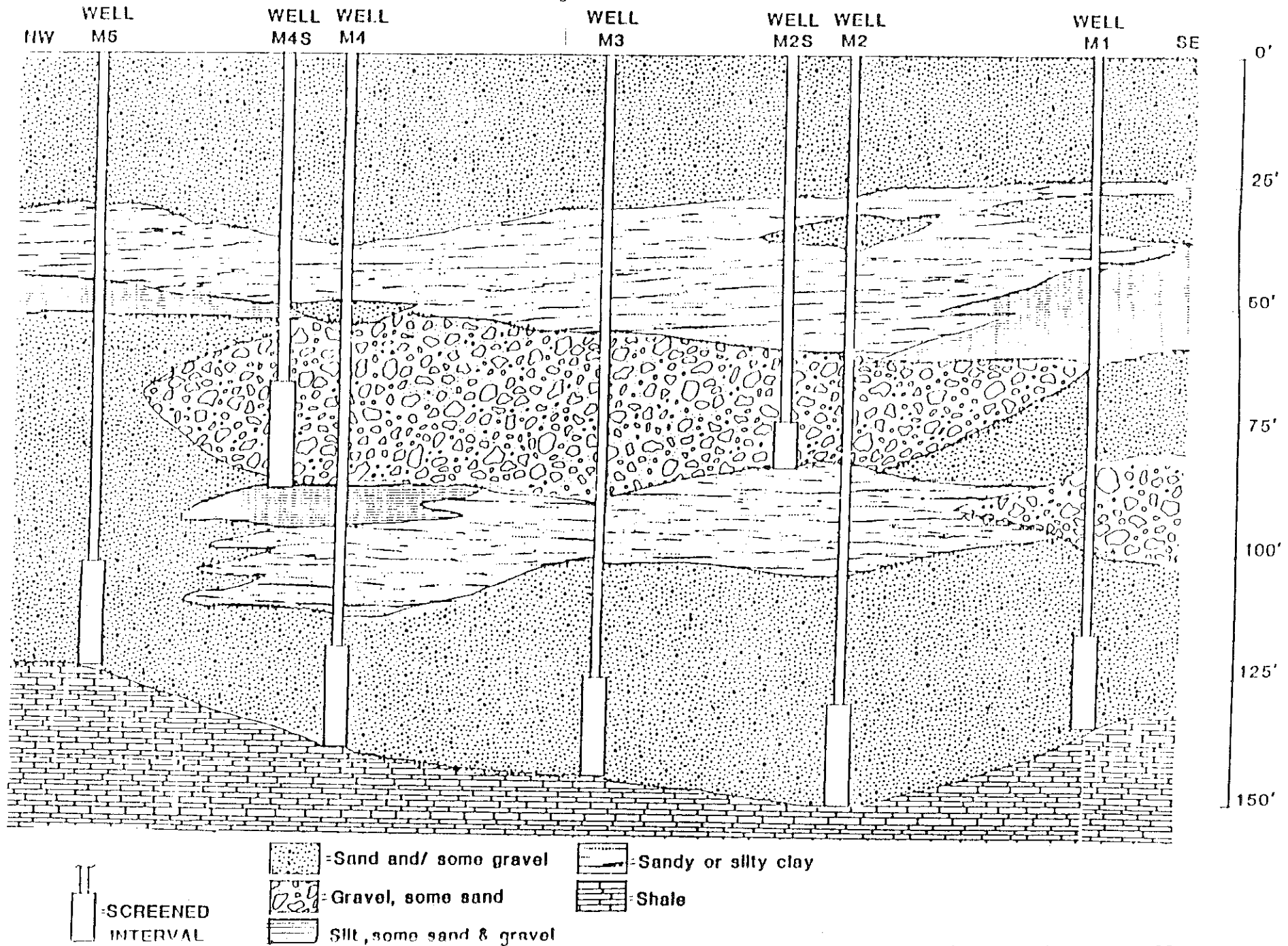
Preferential flow paths from the vicinity of surface impoundment and auxiliary drying area have not been described by the facility, but there are six production wells on site which affect ground water flow direction on and around the plant site.

Figure 9A is a depiction of ground water flow from Norris, 1975. Figure 9B shows a map derived from Du Pont's ground water elevation contour map from March, 1988. The Du Pont wells, from which data was collected to formulate these figures, are non-RCRA wells (both monitoring and production wells) and they are located at a minimum distance of 150 feet east to south of the regulated surface impoundments. Both maps indicate that regional ground water flow direction is to the west-northwest, toward the Scioto River, and that the facility's pumping has significantly lowered the ground water table at the site. The degree of lowering of the ground water table strictly from off-site pumping has not been determined, but Norris (1975) mentions that water levels in the area of Du Pont have been lowered due to the volume of water being pumped by the industrial facilities in the area of Du Pont.

The elevation of the water table ranges from about 623 feet at the pumping center of Production well P4 to about 648 feet along a portion of Du Pont's southern property boundary. Norris (1975) also indicates that the ground water drawn through the Du Pont wells is partially derived from induced infiltration from the Scioto River.

GENERALIZED CROSS-SECTION

Figure 8A



NOTE: Distances between wells not to scale

GENERALIZED CROSS-SECTION

Figure 8B

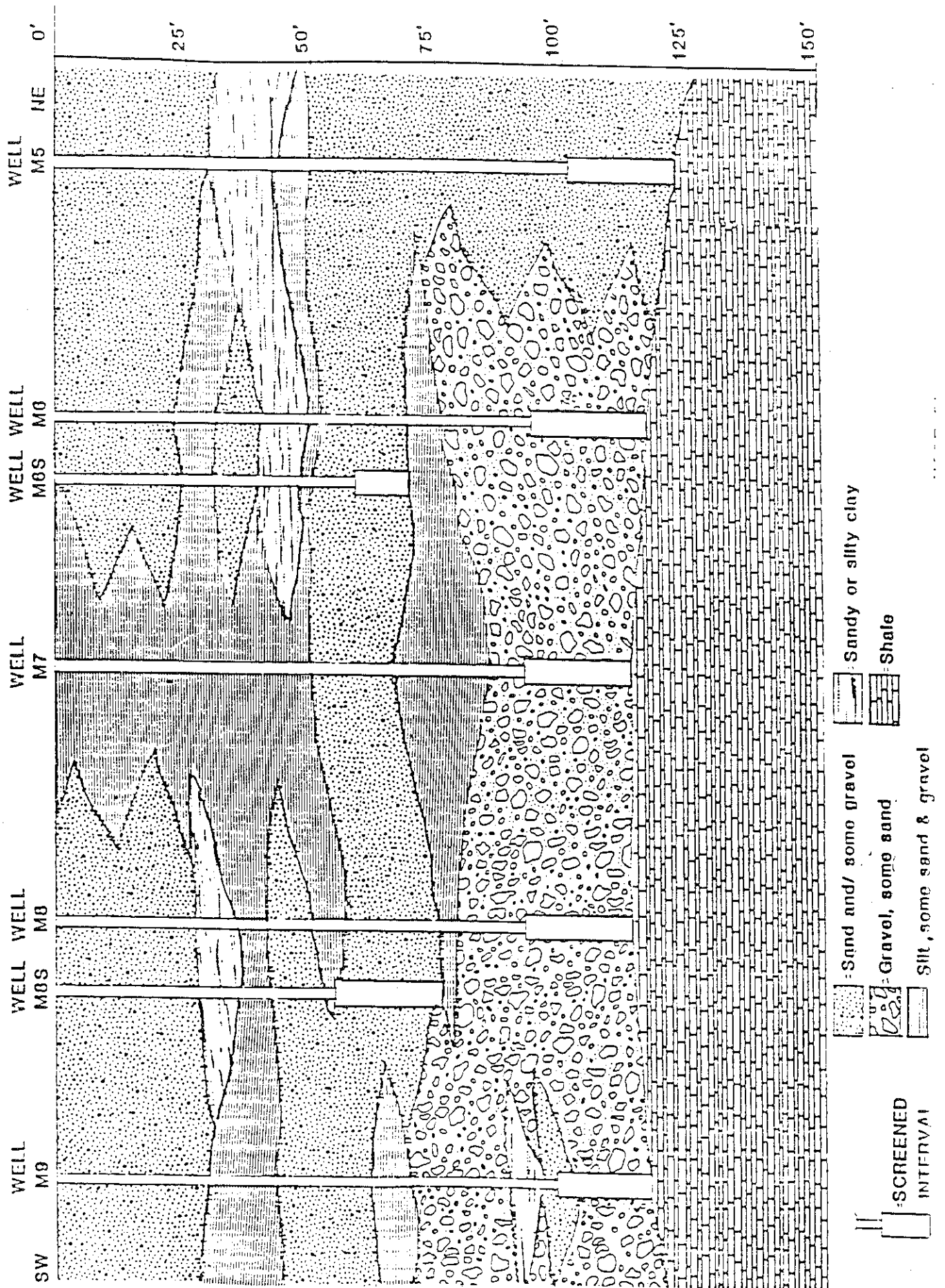
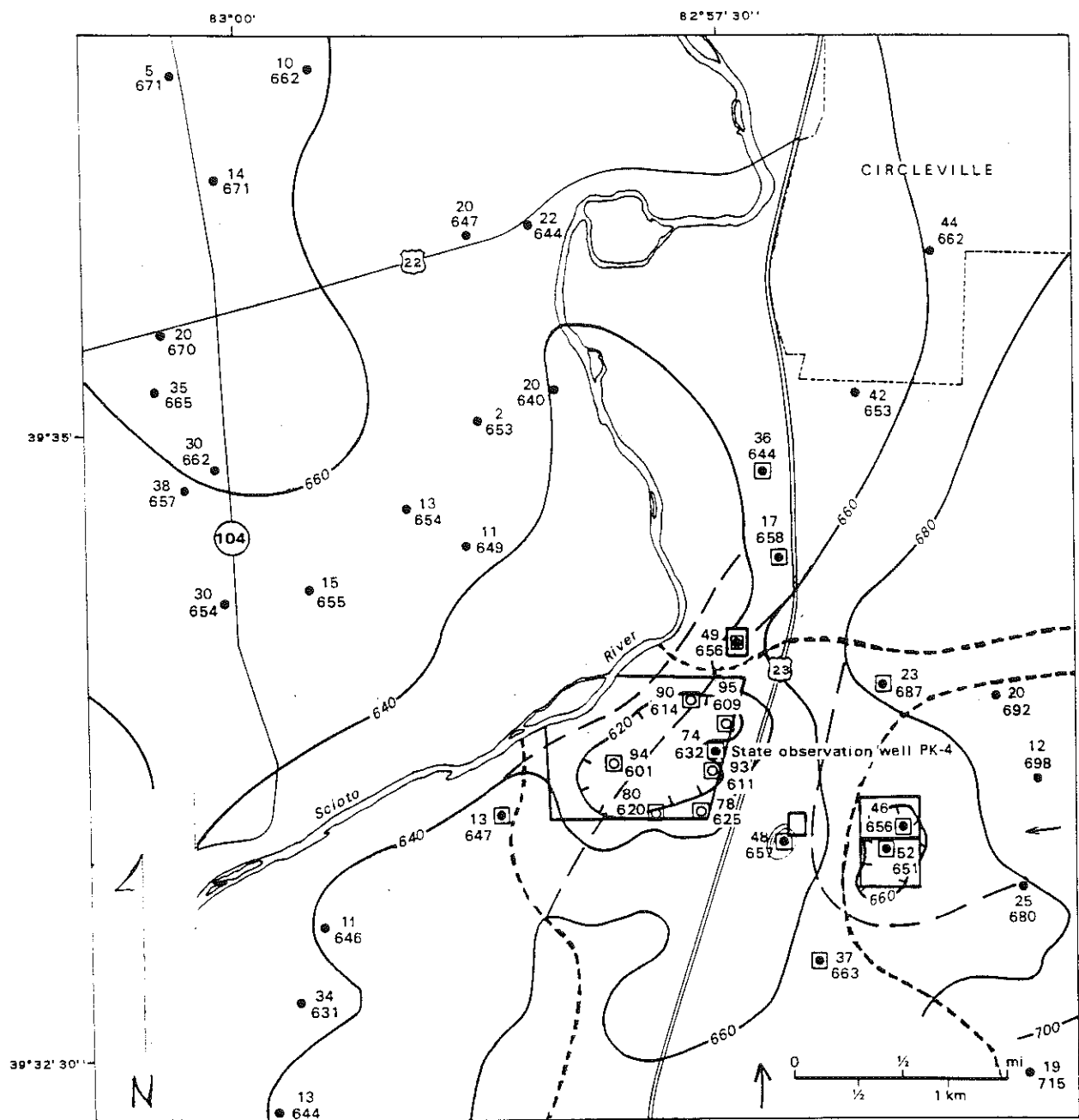


Figure 9A

Potentiometric Surface in
the Circleville Area



—680— Potentiometric contour (ft above sea level),
contour interval 20 ft (6 m)

- - - - - Inferred position of potentiometric contour
before pumping started

- - - - - Ground-water divide

← Direction of ground-water movement

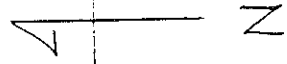
●○ Well location; open circle indicates nearby well
pumping at time of measurement

31 Depth to water (ft below land surface)

640 Altitude of potentiometric surface
(ft above sea level)

□ Well measured in August 1973; water levels
in other wells from drillers' logs and de-
termined at time of drilling

915



Ground Water Withdrawal At and Near Du Pont

Du Pont has eight wells which are used for ground water withdrawal. The facility removes ground water at an average rate of 4.0 million gallons per day (mgd) from the unconsolidated aquifer. Figure 9B shows the well locations and potentiometric contours.

Six of the eight wells are plant production wells and are identified as P2 through P7. At any one time, three or four of the wells will be in operation, pumping an average of 3 mgd. Well P2 is not often operated because water in the area of this well is reportedly high in iron (concentrations unknown). Table 3 shows the tested capacity of Du Pont production wells.

The other two wells are utilized for recovery of ground water in the area of the VCl_2 spill and are identified as DB-2 and DB-3. Total pumpage (for treatment) from DB-2 and DB-3 is 1 mgd. DB-1 is used for monitoring purposes.

Other wells being pumped in the area of Du Pont, which are likely to affect the direction and velocity of ground water flow in the deep sand and gravel aquifer are from the following:

- 1) PPG
- 2) Nekoosa Packaging
- 3) Circle Plastics
- 4) Earnhart-Hill Water District

Although the pumping rates of all of the above facilities is not known, it is estimated that PPG and Nekoosa Packaging withdraw an average total of 3.2 mgd of ground water (Norris 1975). The Earnhart-Hill wells pump about 0.5 mgd.

Ground water levels in the vicinity of these facilities has been documented as continuously declining despite Du Pont's ongoing water conservation program. Since the mid-1970's, Du Pont has decreased pumpage from 4.8 mgd to 4.0 mgd.

Du Pont reported during the August 4, 1988 CME field inspection that, since about 1984 the "perched" zone(s) in the plant area had virtually been dry. This may be due to the installation and pumping of DB-2 and DB-3 in conjunction with the wells being pumped for plant production (P-wells). The affect of the other facilities' wells on the perched zone(s) at Du Pont has not been measured.

Transmissivity of Unconsolidated Deposits

Du Pont documented (June 1988) the unconsolidated deposits beneath their plant as having the following hydraulic conductivities (K).

- Perched Zone: $K = 2 \times 10^{-3}$ cm/s to 4×10^{-3} cm/s
- Clay Underlying the Perched Zone: $K = 3 \times 10^{-8}$ cm/s
- Glacial Aquifer: $K = 3 \times 10^{-2}$ cm/s to 7×10^{-2} cm/s

TABLE 3

Capacity of Du Pont Production Wells

Well No.	Tested Capacity (gallons/minute)
P2	500
P3	1,000
P4	1,000
P5	1,000
P6	1,000
P7	420
DB-2	500
DB-3	200

In conclusion, there are currently no wells existing on the Du Pont, Circleville site which, with the location and construction information available to Ohio EPA, can be considered appropriate as part of a ground water monitoring system with respect to the surface impoundments, and the auxiliary drying area. Even if the construction of the wells was appropriate, the well locations are such that they would not be acceptable to monitor ground water which may have been affected by the surface impoundments and auxiliary drying area.

Detection and Assessment Monitoring Programs

Du Pont has submitted to U.S. EPA, for approval, plans for detection and assessment monitoring as part of their June 23, 1988 "Revised Ground Water Monitoring Plan". Although detection and assessment monitoring programs are discussed, these programs have not been approved nor implemented.

Facility Sampling and Analysis Plan

Du Pont has submitted a proposed sampling and analysis plan (SAP) as a part of their June 23, 1988 "Revised Ground Water Monitoring Plan". This report is currently under review by Ohio and U.S. EPA.

Ground Water Contamination

Because no ground water monitoring system currently exists for the surface impoundments and auxiliary drying area at Du Pont, an evaluation of the water quality in this area cannot be made. The installation of the monitoring system and the implementation of the ground water monitoring program will determine whether contaminants are present in the ground water as a result of the surface impoundments and auxiliary drying area.

The previously noted hazardous waste releases have caused ground water contamination. The first of these is the VCl_2 release. The second is the waste acetone/pyridine release.

Despite Du Pont's efforts to recover and prevent migration of VCl_2 released during and prior to 1981, they estimated that 10,000 pounds to 12,000 pounds reached the deep glacial aquifer. As of July 1988, Du Pont reported that 7,623 pounds of VCl_2 had been extracted. If Du Pont's estimates are correct this would mean that about 2,300 pounds to 4,300 pounds of VCl_2 are still in the deep glacial aquifer.

Until 1986 Du Pont treated the VCl_2 contaminated ground water from wells DB-2 and DB-3 using an aeration system and eventually pumping the water to the surface impoundments. Discharge went through NPDES permit outfall 602 (see figure 10). Currently the combined flow from wells DB-2 and DB-3 is treated using an air stripper and is discharged to NPDES permit outfall 603 (see Figure 10). Outfalls 602 and 603 coverage into outfall 001, which discharges to the Scioto River about one-third mile to the west.

Concentrations of VCl_2 contamination at Du Pont have been monitored, but Du Pont has not submitted the data on a regular basis to Ohio EPA. Information about the VCl_2 spill was presented by Du Pont representatives to Ohio EPA during the CME field inspection. Figure 11 is a graph which Du Pont presented showing the trends of VCl_2 concentration in ground water pumped from well DB-3.

The February 1988 acetone/pyridine release has also been shown to have contaminated ground water. The area where the release occurred is identified in Figure 4 as waste management area 10, and it is described in Table 2. No contamination was detected in the water from the north, east, and west wells (MW-4, MW-3, and MW-2, respectively) but pyridine was discovered in the south well (MW-1) at 31.1 ppm. A detailed diagram of the area is shown in Figure 12. Included are the locations of tanks, the area of excavation, soil sample and soil boring locations, and the newly installed monitor well locations. The area where the acetone/pyridine infiltrated into the soil and was excavated, backfilled with clean soil, and paved over with asphalt. This action was taken in order to prevent infiltration of precipitation which may encourage the migration of acetone/pyridine which is still highly concentrated in the soil.

Ground water samples from Du Pont's production wells P3 and P4 have been shown to contain 1,4-dioxane at concentrations of 0.002 ppm and 0.076 ppm, respectively. The source of this contamination is not certain, but 1,4-dioxane has been detected in several samples from wells hydraulically upgradient (to the east and southeast) of Du Pont's property. Plant employees have been notified of potential health effects of this contaminant at the concentrations measured in wells P3 and P4.

Although many of the waste management units described in Table 2 are potential ground water contaminant sources, their releases to ground water cannot be substantiated.

Soil Contamination

The extent of soil contamination from the pipe which leaked VCl_2 during and prior to 1981 has not been determined, but because the pipe which released the hazardous fluid to ground water was buried in the soil, it is likely that soils in the area also were contaminated.

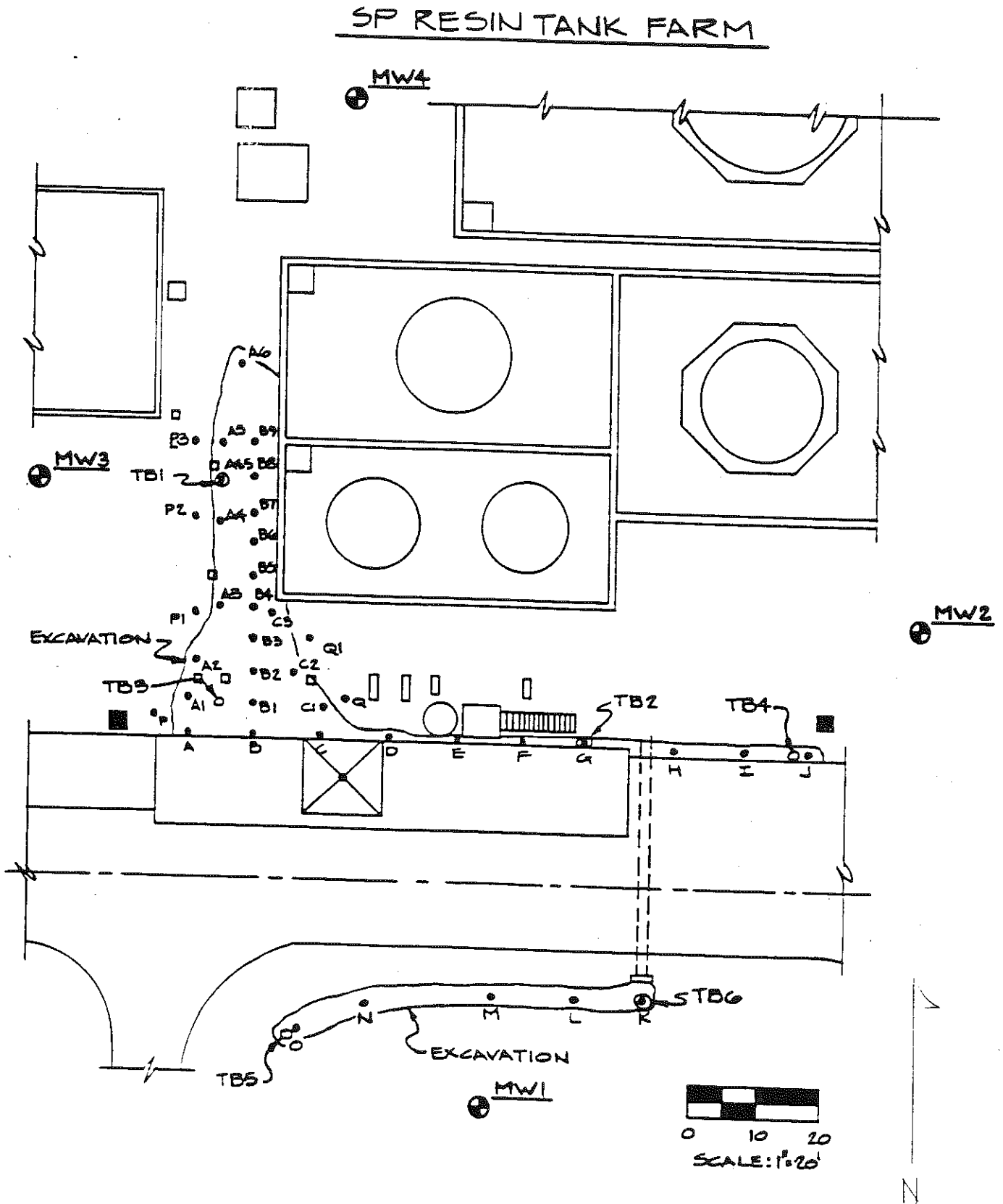
Another soil contaminant area is at the SP-resin tank farm, where the acetone/pyridine release occurred. Profiles showing the levels of contaminant at various depths and within various cross sections of the area, indicate that high levels of both acetone and pyridine are still in the soil. Although much of the soil in this area was taken to hazardous waste landfills, the maximum measured concentrations of acetone/pyridine left in the soil and the depth from the original land surface at which they are found, are listed as follows:

	<u>Concentration (ppm)</u>	<u>Approximate Depth (ft.)</u>
Acetone:	6,902	11
Pyridine:	9,650	12

DB3 VCL2 SAMPLE DATA
9 MONTH AVERAGE
CIRCLEVILLE PLANT



Figure 12



Surface Water Contamination

On two occasions Du Pont has violated their current NPDES permit limits for VCl_2 from the air stripper effluent (NPDES permit outfall 603) which is eventually discharged to the Scioto River. These violations occurred in February 1987 and July 1987 at monthly average concentrations of 0.0426 ppm and 0.0277 ppm, respectively. The acceptable monthly maximum average is 0.025 ppm. Both violations were corrected by shutting down the air stripper and then cleaning or replacing the filter pack material in the air stripper.

The facility has not been known to have violated the current NPDES permit limits on discharges from the surface impoundment (NPDES permit outfall 602), which is used to treat cooling and process waters from the plant operations.